Health System Re-engineering: A CPRS Economic Decision Model

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The fundamental problem with the health care delivery system remains too little health delivered for too great a cost. Information essential to sound clinical and administrative decision making is too frequently missing at the time and place of decision. Automated systems offer opportunities both to improve health and to reduce cost through effective and efficient information management. Information systems are the enabling technology for those business practice changes which improve the benefit-cost profile of a re-engineered delivery system. The Computer-based Patient Record (CPR) is the organizing framework of an enterprise-wide health information system. Since information management is a core function of the health care enterprise, evaluation of the CPR should include its impact on the value of health outcomes and contribution to the organizational mission, rather than solely by benefits which accrue within the delivery system. This paper proposes a model to measure the impact of information technology and specifically a CPR on a re-engineered health care delivery system.

INTRODUCTION

We have a long believed that automation will benefit both the patient and the delivery system. Although CPR references are too numerous for detailed citation, several recent publications outside the medical informatics community state the need for the CPR, summarize its evolution, and underscore the need for standards and models. The CPR has been identified as the key and essential ingredient of health care reform.[1] CPR requirements and features have also been reviewed in the information systems trade press.[2] Leavitt recently summarized the potential benefits of the CPR as cost savings, e.g. $4 to $9 for each patient chart pulled and refilled, and as cost avoidance, e.g. 200,000 elderly hospitalizations annually for preventable adverse medication reactions.[3]

Predicted economic benefits of a CPR system (CPRS) remain, however, difficult to obtain. Many of the promised benefits of automation are unrealized because automating existing work patterns only adds non-value-added work.[4] When faced with similar needs over the past decade, the business community found a solution in re-engineering.[5,6] Re-engineering has mistakenly become synonymous with the corporate bloodletting of the past decade. More than a cost-cutting shedding of middle management, re-engineering is a fundamental overhaul of an organization. The key to re-engineering success is to reduce or eliminate activities which do not add value to organizational missions, <u>and</u> to re-invest the savings thus obtained in value-added organizational functions.

Re-engineering has been increasingly applied to health services.[7,8] As part of the Integrated Computer Aided Manufacturing (ICAM) program, the United States Air Force developed a systems definition methodology termed ICAM Definition (IDEF). This methodology allows for graphical modeling of organizational activities and the resultant data requirements.[9] IDEF process and data modeling tools have been shown effective in health service re-engineering.[10]

Re-engineering with IDEF tools may be accomplished at the department, enterprise, state or national level.[11] Augustine reported using the IDEF methodology in an enterprise-wide re-engineering effort.[12] Re-engineering of the Military Health Services System (MHSS) began in 1989 under the DoD Corporate Information Management (CIM) initiative.[13] The IDEF methodology has been used extensively in this effort. Functional areas (e.g. health care services) prepared To-Be IDEF-0 activity models and determined supporting data requirements through IDEF-1X data models. These data models were converged into an MHSS enterprise-wide data model. The MHSS CPR exists as one of many views of this enterprise data model.

FOUNDATION ANALYSIS OF THE CPR

Analysis revealed that the CPR and its implementing information system constitute the *organizing framework* of a re-engineered health care delivery system.[14] The requirements for the CPR were best described as *model-based*, *standards-compliant*, and *cost-justified* by a comprehensive economic analysis model. Several observations about the CPR become apparent in this analysis.

First and foremost, the patient is the center of the health service process. Professional services add value to the patient through improving and maintaining health. The patient is therefore always under care, in health and not. Value-added patient service is the reality of managed care. When activity based costing is triggered in the IDEF-0 activity model the output becomes not only the cost of services or procedures but the value of health to the individual and society. When aggregating activity-based costs, the IDEF-0 activity model draws upon resource costs identified through the IDEF-1X enterprise data model.

A continuity of data must be available at the time and location of decision making to support continuous, value-added patient service. In the To-Be environment there can be no data segmentation by discipline or service as in the traditional "inpatient record", "outpatient record", or "dental record". With such a data continuum the To-Be CPR will exist as a virtual assemblage of patient information. This information is accessed by a presentation vehicle, the implementing CPRS or health service provider interface. As our conventional view of the CPR is surpassed by an understanding of computer-based patient *information*, the CPR becomes a construct which time and technology have passed by.

Therefore, in the future automated environment, evaluation of the CPR and its CPRS must be in terms of value-added to the patient, to the society and within the delivery system.

A CPR QUANTITATIVE DECISION MODEL

The traditional evaluation measures for healthcare delivery systems are cost, quality and access. While appropriate for the As-Is environment, these measures fall short for evaluation of the range of service modalities possible in a To-Be environment. The bottom line of any health service re-engineering effort is to find the most beneficial use of limited resources. This determination may be accomplished through a structured, cost-benefit approach tailored to the unique requirements of an individual delivery system.

The focus of this model is marginal cost and benefits, based upon quantified micro-level metrics reflecting value to the patient, society and the delivery system. Metric classes are efficacy of service for patient service, effectiveness of the health service to the community (employer or society), and cost efficiency for the health care organization. Typical metrics for the efficacy class are a health assessment score and personal value-added. The community or employer class metrics may include a population health assessment and the value of work absence avoided. Cost efficiency within the organization includes measures for health service provider effectiveness, activity cost and return on investment. Specific measures identify linkages between resource inputs and value-added outputs at the most reasonable level of aggregation.

The model is generalizable across the spectrum of possible health service delivery mechanisms in the To-Be environment. Cells in the table contain the variable, a score and an a priori coefficient determined by the organization leadership and/or mission. In an employer-financed managed care system, for example, the community class measures may be more important than these would to a conventional fee-for-service delivery system.

USING THE DECISION MODEL

This model provides process-oriented analytical metrics for evaluation and managerial decision making for the entire health service organization during and after re-engineering. When taken over time, these metrics can also provide indices for decision guidance and an input for statistical process control. Tables I and II illustrate using the model to prioritize CPRS investment and to monitor performance of a managed care CPRS in terms of benefits received.

Table I. demonstrates the difference between conventional and health value-added benefits assessment for purposes of prioritizing development and implementation of two competing CPRSs. In this table, the italicized entries are health value additions to current benefits assessment measures. If we consider only those traditional benefits which accrue within the delivery system, improved provider effectiveness and cost savings, the value-added totals for the Inpatient and Outpatient CPRS are 177 and 120 respectively. The Return on Investment (ROI) for the Inpatient versus Outpatient CPRS (150 to 130) and the Evaluation Index (327 v. 250) clearly favor the Inpatient CPRS. It would be the logical choice for implementation under a constrained budget. However, when the benefits which accrue to the customer are considered as quantifiable benefits of *health* in a managed care environment, the analysis slightly favors the Outpatient CPRS.

Table I. Sample decision matrix to prioritize Inpatient vs Outpatient CPRS investment (fictitious data).

MICRO-METRIC	A PRIORI WEIGHT	Inpatient CPRS $VA	Outpatient CPRS $VA	Inpatient CPRS (weighted)	Outpatient CPRS (weighted)
personal health assessment	.15	98	98	14.70	14.70
personal value added	.15	125	130	18.75	19.50
population health assessment	.15	95	98	14.25	14.70
value of work absence avoided	.19	265	325	50.35	61.75
health service provider effectiveness	.12	92	80	11.04	9.60
activity cost savings	.12	85	40	10.20	4.80
return on $100 CPRS investment	.12	150	130	18.00	15.60
Evaluation Index	**1.00**	**910**	**901**	**137.29**	**140.65**

Table II. illustrates proportional a priori weighting of the same micrometrics for performance assessment. As previously, the italicized entries are additions to current benefits assessment measures considered for managed care in this model. The metrics relate weighted comparisons as value-added dollars among the Baseline, and predicted and obtained performance measures for business process improvements. If only the conventional performance metrics are considered, for benefits which accrue within the enterprise, the CPRS is only marginally successful. If, however, the CPRS operates in a managed care environment where health benefits are valued, the model demonstrates the CPRS has enabled substantial value added through business process improvement. These micrometrics may be fed into a decision support or executive information system for activity and enterprise-wide performance monitoring through statistical process control.

Table II. Sample performance monitoring of Managed Care CPRS using Economic Decision Model (fictitious data).

MICRO-METRIC	A PRIORI WEIGHT	BASELINE $VA	TARGET $VA	ACTUAL $VA
personal health assessment	1.25	90	95	98
personal value-added	1.25	125	150	185
population health assessment	1.25	95	98	98
value of work absence avoided	1.40	254	325	350
health service provider effectiveness	1.00	75	95	92
activity cost savings	1.00	00	87	85
return on $100 CPRS investment	1.00	100	130	150

CONCLUSION

Traditional economic analysis methods apply benefits to the delivery system and consider benefits outside of the delivery system to be soft or non-quantifiable. Managed care will force a change in this viewpoint because employers are able to quantify benefits of employee healthfulness in terms of increased productivity through reduced absence. The CPR and CPRS are the organizing framework and enabling technology to obtain benefits in a re-engineered health enterprise. This model is suitable for CPRS investment decisions and monitoring the effects of business process improvements monitoring in both conventional and managed care environments. This model indicates the CPR and CPRS will have greatest economic impact in a managed care system serving employers and other organizations with high labor costs.

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